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Willard Reservoir
Box Elder County, Utah

National Eutrophication Survey, Corvallis, Oreg

Prepared for

Corvallis Environmental Research Lab, Oreg

Nov 77

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U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

REPORT
ON
WILLARD RESERVOIR
BOX ELDER COUNTY
UTAH
EPA REGION VIII
WORKING PAPER No. 862

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON
and
ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

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REPORT

ON

WILLARD RESERVOIR

BOX ELDER COUNTY

UTAH

EPA REGION VIII

WORKING PAPER No. 862

WITH THE COOPERATION OF THE

UTAH STATE DIVISION OF HEALTH

AND THE

UTAH NATIONAL GUARD

NOVEMBER, 1977

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGEMENT

The staff of the National Eutrophication Survey (Office of Research and Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the Utah Department of Social Services and the Utah Department of Natural Resources for professional involvement, to the Utah National Guard for conducting the tributary sampling phase of the Survey, and to those Utah wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

The staffs of the Bureau of Water Quality of the Division of Health and the Division of Wildlife Resources provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

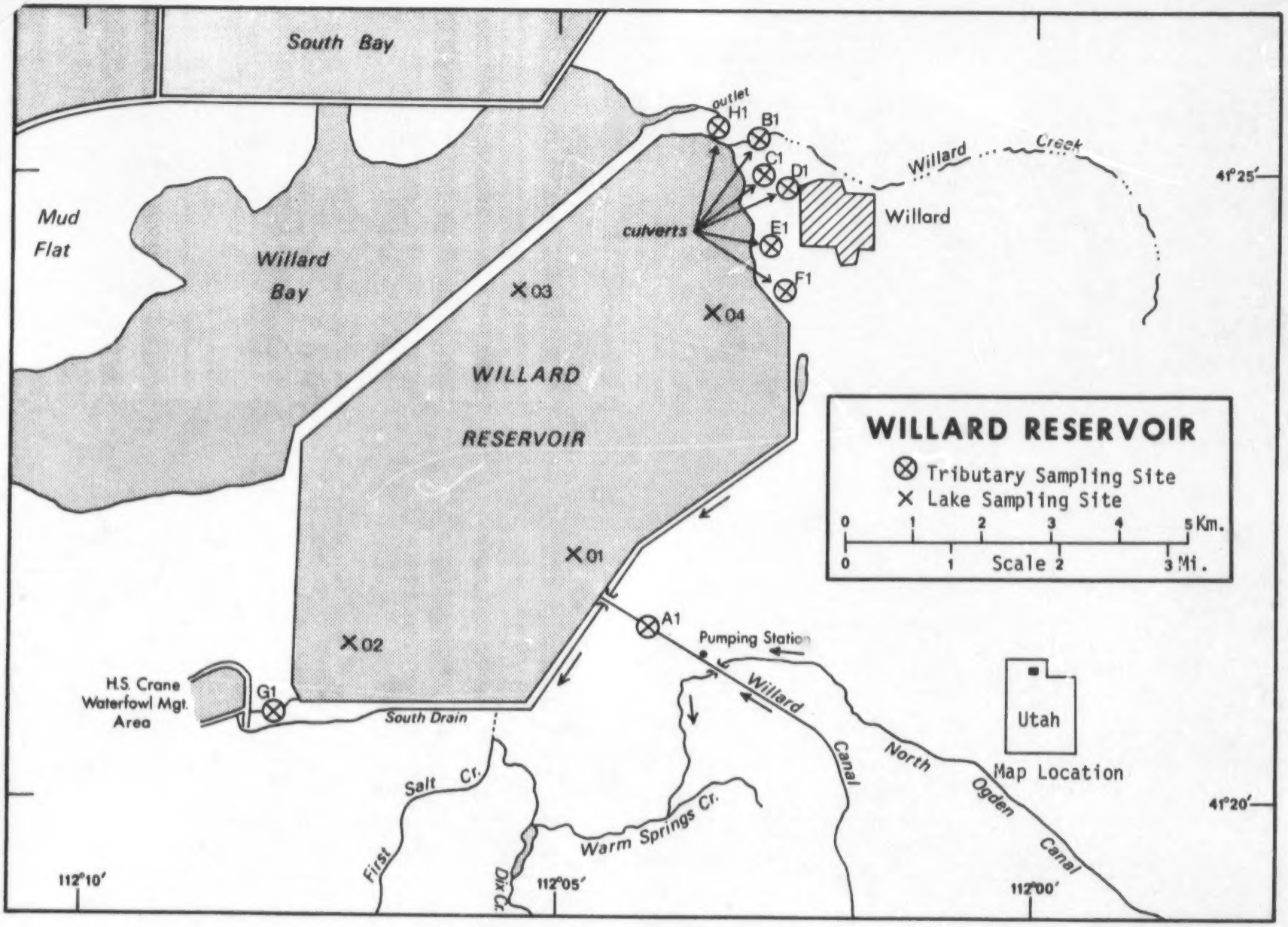
Major General Maurice L. Watts, the Adjutant General of Utah, and Project Officer Lt. Colonel T. Ray Kingston, who directed the volunteer efforts of the Utah National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES AND RESERVOIRS

STATE OF UTAH

NAME	COUNTY
Bear	Rich, UT; Bear Lake, ID
Deer Creek	Wasatch
Echo	Summit
Fish	Sevier
Flaming Gorge	Daggett, UT; Sweetwater, WY
Huntington	Emery
Joes Valley	Emery
Lower Bowns	Garfield
Lynn	Box Elder
Minersville	Beaver
Moon	Duchesne
Navajo	Kane
Newcastle	Iron
Otter Creek	Piute
Panguich	Garfield
Pelican	Uintah
Pineview	Weber
Piute	Piute
Porcupine	Cache
Powell	Garfield, Kane, San Juan, UT; Coconino, AZ
Pruess	Millard
Sevier Bridge	Juab, Sanpete
Starvation	Duchesne
Steinaker	Uintah
Tropic	Garfield
Utah	Utah
Willard Bay	Box Elder


WILLARD RESERVOIR
Tributary Sampling Site
Lake Sampling Site
0 1 2 3 4 5 Km.
0 1 Scale 2 3 Mi.
South Bay
Mud Flat
Willard Bay
WILLARD RESERVOIR
outlet
H1
B1
C1
D1
E1
F1
culverts
Willard Creek
Willard
41°25′
41°20′
X03
X04
X01
X02
A1
Pumping Station
Willard Canal
North Ogden Canal
Utah
Map Location
H.S. Crane Waterfowl Mgt. Area
G1
South Drain
Salt Cr.
First
Dix Cr.
Warm Springs Cr.
112°10′
112°05′
112°00′

WILLARD RESERVOIR

STORET NO. 4925

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Willard Reservoir is eutrophic. It ranked eighteenth in overall trophic quality among the 27 Utah lakes and reservoirs sampled in 1975 when compared using a combination of six water quality parameters*. Sixteen of the water bodies had less and one had the same median total phosphorus, 18 had less and one had the same median dissolved orthophosphorus, 14 had less and one had the same median inorganic nitrogen, 15 had less mean chlorophyll a, and 23 had greater mean Secchi disc transparency. Some depression of dissolved oxygen with depth occurred at station 2 in August (4.0 mg/l at 1.5 meters).

Survey limnologists noted surface algal scums at all four sampling stations in May and September.

B. Rate-Limiting Nutrient:

The algal assay results are not considered representative of conditions in the reservoir at the times the samples were collected (05/14/75 and 09/23/75). However, the reservoir data indicate nitrogen limitation at all sampling stations and times.

C. Nutrient Controllability:

1. Point sources--It is estimated that the Southern Pacific Railroad wastewater treatment facility contributed 1.3% of the

* See Appendix A.

total phosphorus load to Willard Reservoir during the sampling year, assuming all of the phosphorus discharged reached the reservoir. However, the effluent is discharged to the Weber River southeast of the reservoir and would impact the reservoir only when river water is diverted at Slaterville into Willard Canal and thence into the reservoir.

Personnel of the Utah Bureau of Environmental Health report that Willard Canal essentially has a zero gradient, and water can be diverted into or pumped out of the reservoir via the canal; however, water is pumped out only infrequently to insure the pumps are operating properly (Hinshaw, 1976; Tate, 1976). The flow data provided by the U.S. Geological Survey indicate diversion into the reservoir only in May and in June of the sampling year (see Appendix C). If no diversion occurred at other times, the phosphorus contribution of the railroad facility was much less than the indicated 1.3%.

The phosphorus loading of 0.21 g/m^2 measured during the sampling year is less than that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 12), but the trophic condition of the reservoir indicates the loading ordinarily is greater than that; i.e., it would be expected that a higher loading would result in years during which more frequent diversions to the reservoir via Willard Canal occurred.

2. Non-point sources--Non-point source contributed nearly all of the phosphorus inputs to the reservoir during the sam-

pling year. The Willard Canal accounted for 84.4% of the total load, and the remaining six gaged tributaries collectively contributed 5.8%.

II. RESERVOIR AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 40.47 kilometers^2.

2. Mean depth: 5.9 meters.

3. Maximum depth: 11.0 meters.

4. Volume: 240.531 x 10^6 m^3.

5. Mean hydraulic retention time: 3.3 years (based on outflow).

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Willard Canal	-	2.250
Unnamed Stream B-1	12.6	0.184
Unnamed Stream C-1	2.3	0.020
Unnamed Stream D-1	0.3	0.011
Unnamed Stream E-1	1.6	0.006
Unnamed Stream F-1	4.9	0.042
Unnamed Stream G-1	-	0.057
Minor tributaries & immediate drainage -	-	-
Totals	21.7	2.570

2. Outlet -

Unnamed Stream H-1	62.2**	2.340

C. Precipitation***:

1. Year of sampling: 78.5 centimeters.

2. Mean annual: 51.1 centimeters.

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† Table of metric equivalents--Appendix B.
†† Sudweeks, 1975.
* For limits of accuracy, see Working Paper No. 175, "... Survey Methods, 1973-1976".
** Includes area of reservoir.
*** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Willard Reservoir was sampled three times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at four stations on the reservoir (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first and last visits, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 4.0 meters at station 1, 4.9 meters at station 2, 5.5 meters at station 3, and 5.2 meters at station 4.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR WILLARD BAY RESERVOIR
STORET CODE 4925

PARAMETER	1ST SAMPLING (5/14/75) 4 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (8/ 6/75) 4 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/23/75) 4 SITES RANGE	MEAN	MEDIAN
TEMP (C)	9.7 - 15.3	12.5	13.0	23.0 - 27.0	25.1	25.4	19.5 - 20.0	19.8	19.8
DISS OXY (MG/L)	8.8 - 11.2	10.1	10.2	4.0 - 9.8	8.3	8.8	5.5 - 9.1	7.6	7.8
CNDCTVY (MCROMO)	596. - 983.	886.	900.	1000. - 1063.	1028.	1026.	977. - 996.	989.	989.
PH (STAND UNITS)	8.7 - 8.9	8.8	8.8	8.6 - 9.3	9.0	9.0	8.2 - 8.8	8.7	8.8
TOT ALK (MG/L)	167. - 175.	170.	170.	164. - 176.	170.	170.	127. - 176.	171.	175.
TOT P (MG/L)	0.038 - 0.058	0.048	0.047	0.029 - 0.067	0.045	0.041	0.022 - 0.090	0.048	0.041
ORTHO P (MG/L)	0.005 - 0.016	0.009	0.009	0.007 - 0.038	0.015	0.011	0.006 - 0.012	0.008	0.007
NO2+NO3 (MG/L)	0.020 - 0.050	0.022	0.020	0.020 - 0.040	0.022	0.020	0.020 - 0.080	0.025	0.020
AMMONIA (MG/L)	0.020 - 0.040	0.034	0.035	0.020 - 0.080	0.035	0.030	0.020 - 0.160	0.064	0.040
KJEL N (MG/L)	0.500 - 0.800	0.592	0.600	0.500 - 0.800	0.583	0.600	0.400 - 1.300	0.733	0.800
INORG N (MG/L)	0.040 - 0.090	0.057	0.055	0.040 - 0.120	0.057	0.050	0.040 - 0.180	0.089	0.070
TOTAL N (MG/L)	0.520 - 0.850	0.614	0.620	0.520 - 0.830	0.606	0.620	0.480 - 1.320	0.758	0.820
CHLRPYL A (UG/L)	8.0 - 11.8	10.4	10.8	4.0 - 10.0	7.0	7.1	2.7 - 11.6	5.3	3.4
SECCHI (METERS)	0.6 - 0.9	0.7	0.7	0.9 - 2.1	1.6	1.8	0.9 - 1.2	1.1	1.1

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
05/14/75	1. Ankistrodesmus sp.	2,412
	2. Cryptomonas sp.	36
	Total	2,448
08/06/75	1. Melosira sp.	2,987
	2. Fragilaria sp.	1,873
	3. Cryptomonas sp.	253
	4. Oocystis sp.	202
	5. Ankistrodesmus sp.	202
	Other genera	48
	Total	5,568
09/23/75	1. Aphanizomenon sp.	1,104
	2. Cryptomonas sp.	28
	Total	1,132

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
05/14/75	1	8.0
	2	10.7
	3	11.8
	4	11.0
08/06/75	1	10.0
	2	4.0
	3	8.4
	4	5.8
09/23/75	1	11.6
	2	4.0
	3	2.8
	4	2.7

C. Limiting Nutrient Study:

The algal assay results are not considered representative of conditions in the reservoir at the times the samples were collected (05/14/75 and 09/23/75) due to significant changes in the nutrient concentrations in the samples during shipment from the field to the laboratory.

The reservoir data indicate nitrogen limitation all three sampling times. The mean inorganic nitrogen/orthophosphorus ratios were 6/1 in May, 4/1 in August, and 11/1 in September, and nitrogen limitation would be expected.

Nitrogen limitation, as indicated by the algal assay or by in-reservoir nitrogen to phosphorus ratios, does not necessarily mean that the trophic condition of the reservoir can be improved by controlling nitrogen inputs. In many cases, the apparent condition of nitrogen-limitation results from excessive phosphorus input from point sources and is often accompanied by a corresponding increase in primary production. In such cases, the reversal of the enriched condition depends upon phosphorus control, not nitrogen control.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Utah National Guard collected monthly near-surface grab samples when possible from each of the tributary sites indicated on the map (page v). Sampling was begun in November, 1974, and was completed in September, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Utah District Office of the U.S. Geological Survey for the tributary sites nearest the reservoir.

In this report, nutrient loads for sampled tributaries were calculated using mean annual concentrations and mean annual flows. Nutrient loads shown are those measured minus point-source loads, if any.

The operator of the Southern Pacific Railroad wastewater treatment facilities provided monthly effluent samples and corresponding flow data.

A. Waste Sources:

1. Known domestic -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
So. Pacific RR*	?	stab. pond	579.9	Weber River

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (non-point load) -		
Willard Canal	7,055	84.4
Unnamed Stream B-1	325	3.9
Unnamed Stream C-1	30	0.4
Unnamed Stream D-1	10	0.1
Unnamed Stream E-1	5	< 0.1
Unnamed Stream F-1	25	0.3
Unnamed Stream G-1	90	1.1
b. Minor tributaries & immediate drainage (non-point load) -	-	-
c. Known municipal STP's -		
Southern Pacific RR	110	1.3
d. Septic tanks - Unknown	?	-
e. Known industrial - None	-	-
f. Direct precipitation** -	710	8.5
Total	8,360	100.0

2. Outputs -

Lake outlet - Unnamed Stream H-1 7,380

3. Net annual P accumulation - 980 kg.

* Hinshaw, 1974
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Willard Canal	149,795	70.7
Unnamed Stream B-1	7,510	3.6
Unnamed Stream C-1	1,300	0.6
Unnamed Stream D-1	620	0.3
Unnamed Stream E-1	475	0.2
Unnamed Stream F-1	3,815	1.8
Unnamed Stream G-1	3,140	1.5
b. Minor tributaries & immediate drainage (non-point load) -	-	-
c. Known municipal STP's -		
Southern Pacific RR	1,485	0.7
d. Septic tanks - Unknown	?	-
e. Known industrial - None	-	-
f. Direct precipitation* -	43,690	20.6
Total	211,770	100.0

2. Outputs -

Lake outlet - Unnamed Stream H-1 124,710

3. Net annual N accumulation - 87,060 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Unnamed Stream B-1	26	596
Unnamed Stream C-1	13	565
Unnamed Stream D-1	33	2,067
Unnamed Stream E-1	3	259
Unnamed Stream F-1	5	779

* See Working Paper No. 175.

E. Mean Nutrient Concentrations in Willard Canal:

Mean Total P Conc. (mg/l)	Mean Total N Conc. (mg/l)
0.101	2.132

F. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	0.21	0.02	5.2	2.2

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Willard Reservoir:

"Dangerous" (eutrophic loading)	0.26
"Permissible" (oligotrophic loading)	0.13

V. LITERATURE REVIEWED

Hinshaw, Russ, 1974. Treatment plant questionnaire. UT Bur. of Env. Health, Salt Lake City.

_____, 1976. Personal communication (point-source impacts on Willard Reservoir). UT Bur. of Env. Health, Salt Lake City.

Sudweeks, Calvin K., 1975. Personal communication (reservoir morphometry). UT Bur. of Env. Health, Salt Lake City.

Tate, William, 1976. Personal communication (hydrology in the Willard Reservoir drainage). UT Bur. of Env. Health, Salt Lake City.

Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE CODE	LAKE NAME	TOTAL MEAN	TOTAL MEDIAN	THOUSAND MEAN	THOUSAND MEDIAN	200-SEC MEAN	200-SEC MEDIAN	2-SEC MEAN	2-SEC MEDIAN	MEAN	MEDIAN
2002	LAWRENCE DONGE RESERVOIR	0.011	0.000	0.000	582.000	32.000	10.000	00.000	0.000	0.000	0.000
2002	KIRTON RESERVOIR	0.004	0.000	0.000	0.000	4.283	11.000	11.000	0.000	0.000	0.000
2004	OLEN LAKE	0.135	0.250	0.000	0.000	33.433	11.000	11.000	0.000	0.000	0.000
2053	IRONIC RESERVOIR	0.051	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000
2055	ZEERINGA RESERVOIR	0.011	0.000	0.000	0.000	1.000	15.000	15.000	0.000	0.000	0.000
2051	ZIRANYANA RESERVOIR	0.010	0.000	0.000	0.000	0.000	0.000	12.000	0.000	0.000	0.000
2050	ZEARIS RUBBER RESERVOIR	0.050	0.000	0.000	0.000	110.000	101.555	15.000	0.000	0.000	0.000
2010	HUNTER RESERVOIR (ERNIE)	0.021	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2018	HUNTLINE RESERVOIR	0.052	0.000	0.000	0.000	0.000	0.000	15.000	0.000	0.000	0.011
2013	KIRTIC RESERVOIR	0.041	0.000	0.000	0.000	0.000	0.000	11.000	0.000	0.000	0.001
2019	GIBERTON RESERVOIR	0.058	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2012	RICTOR LAKE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2014	BRONTECH LAKE	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2015	GLEN CREEK RESERVOIR	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2016	INVERSAFE RESERVOIR	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2021	KERNO LAKE	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2016	MOON LAKE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2000	MIDDLEAFIELD RESERVOIR	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2008	NORTH ARTERY RESERVOIR	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2001	HOWLINGTON HOUSE RESERVO	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2002	LIBERTY	0.005	0.000	0.000	0.000	125.000	25.000	10.000	0.000	0.000	0.000
2002	TAW RESERVOIR	0.151	0.000	0.000	0.000	0.000	0.000	20.000	10.000	0.025	0.025
2004	EFMT RESERVOIR	0.041	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2007	DEEP COLLY RESERVOIR	0.038	0.512	0.000	0.000	0.000	0.000	0.000	0.000	0.015	0.015
2005	FORLD RIVER RESERVOIR	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2001	DEAD LAKE	0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2000	LAKE BURGER	0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2002	LAKE LAKE										
2002	LAKE LAKE										

CONTINUED ON PAGE 30 OF DATA SERIES

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
0408	LAKE POWELL	0.010	0.410	339.830	3.681	13.800	0.007
4901	BEAR LAKE	0.011	0.040	253.167	0.945	9.200	0.003
4902	LOWER BOWN'S RESERVOIR	0.031	0.040	336.000	5.567	9.400	0.006
4903	DEER CREEK RESERVOIR	0.038	0.215	430.333	9.078	14.800	0.006
4904	ECHO RESERVOIR	0.047	0.170	450.333	6.967	14.000	0.012
4905	LYNN RESERVOIR	0.121	0.200	417.667	39.600	10.400	0.052
4906	FISH LAKE	0.023	0.040	152.000	12.483	10.400	0.004
4907	HUNTINGTON NORTH RESERVO	0.013	0.040	392.000	1.900	7.800	0.005
4908	JOE'S VALLEY RESERVOIR	0.012	0.045	400.000	2.483	11.200	0.003
4909	MINERSVILLE RESERVOIR	0.192	0.060	445.000	33.583	8.400	0.107
4910	MOON LAKE	0.008	0.040	381.000	2.700	9.600	0.002
4911	NAVAJO LAKE	0.016	0.040	368.000	2.800	6.000	0.003
4912	NEWCASTLE RESERVOIR	0.051	0.040	428.667	12.467	13.600	0.009
4913	OTTER CREEK RESERVOIR	0.067	0.040	453.667	11.767	10.600	0.033
4914	PANGUITCH LAKE	0.071	0.040	426.500	45.950	14.200	0.010
4915	PELICAN LAKE	0.044	0.000	438.000	0.380	4.400	0.004
4916	PINEVIEW RESERVOIR	0.028	0.300	435.083	5.692	14.600	0.006
4917	PIUTE RESERVOIR	0.047	0.150	482.625	25.329	11.600	0.007
4918	PORCUPINE RESERVOIR	0.025	0.110	440.000	7.860	12.400	0.011
4919	PRUESS RESERVOIR (GARRIS	0.057	0.140	491.000	4.533	8.800	0.008
4920	SEVIER BRIDGE RESERVOIR	0.026	0.355	449.778	18.222	12.400	0.008
4921	STARVATION RESERVOIR	0.016	0.040	394.583	5.675	13.200	0.004
4922	STEINAKER RESERVOIR	0.011	0.040	316.750	1.844	12.600	0.005
4923	TROPIC RESERVOIR	0.021	0.050	425.000	7.200	8.400	0.006
4924	UTAH LAKE	0.132	0.320	490.583	72.012	11.400	0.012
4925	WILLARD BAY RESERVOIR	0.044	0.060	457.182	7.567	11.000	0.009
5605	FLAMING GORGE RESERVOIR	0.011	0.690	285.636	2.500	10.400	0.003

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
0408	LAKE POWELL	96 (25)	4 (1)	81 (21)	73 (19)	15 (4)	42 (11)	311
4901	BEAR LAKE	90 (23)	87 (19)	96 (25)	100 (26)	77 (20)	90 (23)	540
4902	LOWER BOWN'S RESERVOIR	46 (12)	87 (19)	85 (22)	65 (17)	73 (19)	50 (13)	406
4903	DEER CREEK RESERVOIR	42 (11)	19 (5)	42 (11)	35 (9)	0 (0)	58 (14)	196
4904	ECHO RESERVOIR	31 (8)	27 (7)	19 (5)	50 (13)	12 (3)	13 (3)	152
4905	LYNN RESERVOIR	8 (2)	23 (6)	58 (15)	8 (2)	62 (15)	4 (1)	163
4906	FISH LAKE	62 (16)	65 (16)	100 (26)	23 (6)	62 (15)	79 (20)	391
4907	HUNTINGTON NORTH RESERVO	77 (20)	65 (16)	69 (18)	92 (24)	96 (25)	69 (18)	468
4908	JOE'S VALLEY RESERVOIR	81 (21)	58 (15)	62 (16)	85 (22)	46 (12)	96 (25)	428
4909	MINERSVILLE RESERVOIR	0 (0)	44 (11)	27 (7)	12 (3)	85 (22)	0 (0)	168
4910	MOON LAKE	100 (26)	87 (19)	73 (19)	77 (20)	69 (18)	100 (26)	506
4911	NAVAJO LAKE	69 (18)	87 (19)	77 (20)	88 (23)	100 (26)	85 (22)	506
4912	NEWCASTLE RESERVOIR	23 (6)	87 (19)	46 (12)	27 (7)	19 (5)	27 (7)	229
4913	OTTER CREEK RESERVOIR	15 (4)	87 (19)	15 (4)	31 (8)	54 (14)	8 (2)	210
4914	PANGUITCH LAKE	12 (3)	65 (16)	50 (13)	4 (1)	8 (2)	23 (6)	162
4915	PELICAN LAKE	37 (9)	84 (14)	38 (9)	84 (14)	98 (83)	73 (19)	343
4916	PINEVIEW RESERVOIR	50 (13)	15 (4)	38 (10)	58 (15)	4 (1)	58 (14)	223
4917	PIUTE RESERVOIR	27 (7)	31 (8)	8 (2)	15 (4)	38 (10)	46 (12)	165
4918	PORCUPINE RESERVOIR	58 (15)	38 (10)	31 (8)	38 (10)	33 (8)	19 (5)	217
4919	PRUESS RESERVOIR (GARRIS	19 (5)	35 (9)	0 (0)	69 (18)	81 (21)	37 (9)	241
4920	SEVIER BRIDGE RESERVOIR	54 (14)	8 (2)	23 (6)	19 (5)	33 (8)	37 (9)	174
4921	STARVATION RESERVOIR	73 (19)	87 (19)	65 (17)	62 (16)	23 (6)	79 (20)	389
4922	STEINAKER RESERVOIR	85 (22)	87 (19)	88 (23)	96 (25)	27 (7)	65 (17)	448
4923	TROPIC RESERVOIR	65 (17)	50 (13)	54 (14)	46 (12)	90 (23)	50 (14)	363
4924	UTAH LAKE	4 (1)	12 (3)	4 (1)	0 (0)	42 (11)	13 (3)	75
4925	WILLARD BAY RESERVOIR	37 (9)	44 (11)	12 (3)	42 (11)	50 (13)	31 (8)	216
5605	FLAMING GORGE RESERVOIR	90 (23)	0 (0)	92 (24)	81 (21)	62 (15)	90 (23)	415

16

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	4901	BEAR LAKE	540
2	4911	NAVAJO LAKE	506
3	4910	MOON LAKE	506
4	4907	HUNTINGTON NORTH RESERVO	468
5	4922	STEINAKER RESERVOIR	448
6	4908	JOE'S VALLEY RESERVOIR	428
7	5605	FLAMING GORGE RESERVOIR	415
8	4902	LOWER BOWN'S RESERVOIR	406
9	4906	FISH LAKE	391
10	4921	STARVATION RESERVOIR	389
11	4923	TROPIC RESERVOIR	363
12	4915	PELICAN LAKE	343
13	0408	LAKE POWELL	311
14	4919	PRUESS RESERVOIR (GARRIS	241
15	4912	NEWCASTLE RESERVOIR	229
16	4916	PINEVIEW RESERVOIR	223
17	4918	PORCUPINE RESERVOIR	217
18	4925	WILLARD BAY RESERVOIR	216
19	4913	OTTER CREEK RESERVOIR	210
20	4903	DEER CREEK RESERVOIR	196
21	4920	SEVIER BRIDGE RESERVOIR	174
22	4909	MINERSVILLE RESERVOIR	168
23	4917	PIUTE RESERVOIR	165
24	4905	LYNN RESERVOIR	163
25	4914	PANGUITCH LAKE	162
26	4904	ECHO RESERVOIR	152
27	4924	UTAH LAKE	75

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR UTAH 10/18/76

LAKE CODE 4925 WILLARD RES

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 62.2

NORMALIZED FLOWS(CMS)

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
4925A1	0.0	0.0	0.0	2.832	7.079	11.327	5.663	0.0	0.0	0.0	0.0	0.0	0.0	2.250
4925B1	14.0	0.057	0.057	0.142	0.453	0.595	0.481	0.142	0.057	0.057	0.057	0.057	0.057	0.184
4925C1	2.3	0.020	0.025	0.028	0.023	0.020	0.020	0.014	0.014	0.023	0.014	0.017	0.017	0.020
4925D1	0.3	0.011	0.014	0.014	0.011	0.011	0.011	0.008	0.008	0.011	0.008	0.008	0.011	0.011
4925E1	1.6	0.006	0.008	0.008	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
4925F1	4.9	0.042	0.054	0.059	0.048	0.045	0.048	0.031	0.031	0.045	0.031	0.034	0.037	0.042
4925G1	0.0	0.057	0.057	0.057	0.057	0.057	0.057	0.057	0.057	0.057	0.057	0.057	0.057	0.057
4925H1	0.0	0.17	0.17	1.42	5.66	9.91	8.50	1.42	0.17	0.17	0.17	0.17	0.17	2.34
4925ZZ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 62.2
SUM OF SUB-DRAINAGE AREAS = 23.1

TOTAL FLOW IN = 58.82
TOTAL FLOW OUT = 0.0

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
4925A1	11	74	0.0	10	0.0				
	12	74	0.0	15	0.0				
	1	75	0.0						
	2	75	0.0						
	3	75	0.0	9	0.0				
	4	75	8.495	6	0.0				
	5	75	22.653	5	23.220				
	6	75	15.008	27	14.158				
	7	75	0.0						
	8	75	0.0	16	0.0				
	9	75	0.0	13	0.0				
	10	75	0.0						
4925B1	11	74	0.057	10	0.057				
	12	74	0.057	15	0.057				
	1	75	0.057	11	0.057				
	2	75	0.071	9	0.071				
	3	75	0.071	9	0.057				
	4	75	0.042	6	0.023				
	5	75	0.651	5	0.396				
	6	75	0.708	27	0.566				
	7	75	0.311						
	8	75	0.227	16	0.227				
	9	75	0.227	13	0.227				
	10	75	0.170						

TRIBUTARY FLOW INFORMATION FOR UTAH 10/18/76

LAKE CODE 4925 WILLARD RES

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
4925C1	11	74	0.020						
	12	74	0.020						
	1	75	0.020						
	2	75	0.028						
	3	75	0.028						
	4	75	0.028						
	5	75	0.020						
	6	75	0.028						
	7	75	0.017						
	8	75	0.023						
	9	75	0.025						
	10	75	0.020						
4925D1	11	74	0.011						
	12	74	0.011						
	1	75	0.011						
	2	75	0.017						
	3	75	0.020						
	4	75	0.017						
	5	75	0.011						
	6	75	0.014						
	7	75	0.008						
	8	75	0.011						
	9	75	0.014						
	10	75	0.011						
4925E1	11	74	0.006						
	12	74	0.006						
	1	75	0.006						
	2	75	0.008						
	3	75	0.008						
	4	75	0.008						
	5	75	0.006						
	6	75	0.008						
	7	75	0.006						
	8	75	0.006						
	9	75	0.008						
	10	75	0.006						
4925F1	11	74	0.042						
	12	74	0.040						
	1	75	0.042						
	2	75	0.062						
	3	75	0.071						
	4	75	0.065						
	5	75	0.045						
	6	75	0.059						
	7	75	0.037						
	8	75	0.045						
	9	75	0.054						
	10	75	0.040						

TRIBUTARY FLOW INFORMATION FOR UTAH 10/18/76

LAKE CODE 4925 WILLARD RES

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
4925G1	11	74	0.057	10	0.057				
	12	74	0.113	15	0.113				
	1	75	0.113	11	0.113				
	2	75	0.113	9	0.113				
	3	75	0.057	9	0.057				
	4	75	0.071	6	0.057				
	5	75	0.085	5	0.085				
	6	75	0.071	27	0.0				
	7	75	0.028						
	8	75	0.099	16	0.113				
	9	75	0.340	13	0.113				
	10	75	0.453						
4925H1	11	74	0.255	10	0.340				
	12	74	0.142	15	0.142				
	1	75	0.142	11	0.142				
	2	75	0.142	9	0.142				
	3	75	0.142	9	0.142				
	4	75	7.079	6	0.142				
	5	75	17.556	5	14.158				
	6	75	22.653	27	22.653				
	7	75	3.398						
	8	75	0.142	16	0.142				
	9	75	0.142	13	0.142				
	10	75	0.425						
4925ZZ	11	74	0.0						
	12	74	0.0						
	1	75	0.0						
	2	75	0.0						
	3	75	0.0						
	4	75	0.0						
	5	75	0.0						
	6	75	0.0						
	7	75	0.0						
	8	75	0.0						
	9	75	0.0						
	10	75	0.0						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/08/12

492501
41 21 27.0 112 04 57.0 3
WILLARD BAY RESERVOIR
49003 UTAH

150791

11EPALES 2111202
0017 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/14	12	20 0000	13.9	10.2	25	850	8.70	175	0.040	0.800	0.050	0.011
	12	20 0005	13.2	10.0		836	8.70	168	0.040	0.600	0.020	0.007
	12	20 0013	10.5	9.6		596	8.80	167	0.040	0.600	0.020	0.005
75/08/06	17	25 0000	25.7	8.9		1041	9.30	171	0.030	0.600	0.020K	0.014
	17	25 0005	25.4	8.8		1029	9.30	171	0.040	0.600	0.020K	0.009
	17	25 0010	24.8	8.7		1021	9.25	171	0.030	0.600	0.020K	0.010
75/09/23	11	05 0000	20.0	9.1	36	977	8.80	176	0.150	0.800	0.020K	0.008
	11	05 0005	19.7	8.3		985	8.80	174	0.020	0.800	0.020K	0.007
	11	05 0010	19.6	7.8		982	8.60	175	0.040	0.800	0.020K	0.007

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/14	12	20 0000	0.047	8.0	
	12	20 0005	0.054		
	12	20 0013	0.052		
75/08/06	17	25 0000	0.041	10.0	
	17	25 0005	0.041		
	17	25 0010	0.045		
75/09/23	11	05 0000	0.038	11.6	
	11	05 0005	0.038		
	11	05 0010	0.090		

K VALUE KNOWN TO BE LESS THAN INDICATED

25

STORET RETRIEVAL DATE 76/08/12

492502
41 21 05.0 112 07 05.0 3
WILLARD BAY RESERVOIR
49003 UTAH

150791

11EPALES 2111202
0020 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/14	12 40	0000	15.3	10.0	24	983	8.85	172	0.030	0.600	0.020K	0.016
	12 40	0005	14.4	10.2		970	8.85	173	0.040	0.600	0.020K	0.005
	12 40	0016	16.1	9.0		883	8.85	174	0.040	0.500	0.020K	0.007
75/08/06	17 40	0000	23.6	9.2	36	1000	8.95	175	0.040	0.700	0.020	0.025
	17 40	0005	23.3	4.0		1005	8.70	176	0.060	0.800	0.030	0.029
	17 40	0015	23.0	6.8		1003	8.60	164	0.080	0.600	0.040	0.038
75/09/23	11 20	0000	19.9	8.7	48	987	8.75	174	0.030	0.800	0.020K	0.006
	11 20	0005	19.7	7.0		989	8.70	175	0.040	0.600	0.020K	0.007
	11 20	0015	19.5	6.9		988	8.80	176	0.040	0.600	0.020K	0.008

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/14	12 40	0000	0.051	10.7	
	12 40	0005	0.041		
	12 40	0016	0.048		
75/08/06	17 40	0000	0.053	4.0	
	17 40	0005	0.064		
	17 40	0015	0.067		
75/09/23	11 20	0000	0.053	4.0	
	11 20	0005	0.047		
	11 20	0015	0.033		

K VALUE KNOWN TO BE
LESS THAN INDICATED

26

STORET RETRIEVAL DATE 76/08/12

492503
41 23 40.0 112 05 43.0 3
WILLARD BAY RESERVOIR
49003 UTAH

150791

11EPALES 2111202
0021 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/14	14 15	0000	14.9	10.2	35	946	8.90	171	0.040	0.600	0.020K	0.005
	14 15	0005	11.0	10.6		904	8.85	170	0.030	0.500	0.020	0.007
	14 15	0017	9.7	8.8		972	8.70	170	0.030	0.500	0.020	0.013
75/08/06	17 10	0000	27.0	8.8	84	1063	9.35	168	0.020	0.500	0.020K	0.007
	17 10	0005	26.4	9.0		1040	9.00	169	0.020	0.500	0.020K	0.008
	17 10	0018	25.0	8.8		1019	8.95	171	0.030	0.600	0.020K	0.013
75/09/23	10 55	0000	20.0	8.2	36	992	8.80	174	0.060	1.300	0.020K	0.010
	10 55	0005	19.8	7.4		989	8.75	174	0.070	0.800	0.020K	0.009
	10 55	0017	19.7	6.9		991	8.70	175	0.090	0.600	0.020K	0.007

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/14	14 15	0000	0.038	11.8	
	14 15	0005	0.045		
	14 15	0017	0.040		
75/08/06	17 10	0000	0.029	8.4	
	17 10	0005	0.037		
	17 10	0018	0.047		
75/09/23	10 55	0000	0.076	2.8	
	10 55	0005	0.038		
	10 55	0017	0.036		

STORET RETRIEVAL DATE 76/08/12

492504
41 24 25.0 112 03 34.0 3
WILLARD BAY RESERVOIR
49003 UTAH

150791

11EPALES 2111202
0021 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/05/14	14 35	0000	13.4	10.8	27	906	8.90	167	0.020	0.600	0.020K	0.011
	14 35	0005	12.8	10.4		896	8.85	167	0.030	0.600	0.020K	0.012
	14 35	0017	10.9	11.2		884	8.90	167	0.030	0.600	0.020K	0.013
75/08/06	17 00	0000	26.4	9.8	72	1050	8.85	165	0.020	0.500	0.020	0.012
	17 00	0005	25.8	9.0		1037	9.00	166	0.020	0.500	0.020K	0.009
	17 00	0016	25.4	8.2		1023	9.00	167	0.030	0.500	0.020K	0.009
75/09/23	10 35	0000	20.0	8.1	48	994	8.20	127	0.030	0.400	0.080	0.007
	10 35	0005	19.9	7.8		994	8.80	174	0.040	0.500	0.020K	0.006
	10 35	0015	19.8	5.5		996	8.60	175	0.160	0.800	0.020	0.012

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/05/14	14 35	0000	0.042	11.0	
	14 35	0005	0.055		
	14 35	0017	0.058		
75/08/06	17 00	0000	0.038	5.8	
	17 00	0005	0.036		
	17 00	0016	0.041		
75/09/23	10 35	0000	0.022	2.7	
	10 35	0005	0.044		
	10 35	0015	0.065		

K VALUE KNOWN TO BE
LESS THAN INDICATED

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APPENDIX E

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 76/08/12

4925A1
41 04 05.0 112 21 06.0 4
WILLARD CANAL
49 7.5 PLAIN CITY
O/WILLARD RESERVOIR 150791
BNK .2 MI W OF WILLARD PUMPING ST NO 1
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	10 45		0.071	1.600	0.130	0.015	0.050
74/12/15	08 50		0.100	0.800	0.065	0.015	0.050
75/03/09	13 45		1.625	1.600	0.092	0.048	0.060
75/04/06	10 30		0.005	2.500	0.090	0.050	0.100
75/05/05	10 45		0.360	1.300	0.155	0.055	0.260
75/06/27	10 15		0.220	0.950	0.050	0.020	0.110
75/08/16	10 00		0.010	4.650	0.052	0.010	0.085
75/09/13	12 50		0.012	1.250	0.060	0.010	0.090

STORET RETRIEVAL DATE 76/08/12

492581
41 25 12.0 112 23 05.0 4
WILLARD CREEK
49 7.5 WILLARD
T/WILLARD RESERVOIR 150791
SEC RD BRDG 1.2 MI NW OF WILLARD
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	09 30		0.320	0.700	0.045	0.010	0.030
74/12/15	09 05		0.352	0.200	0.035	0.015	0.050
75/02/09	09 15		0.320	2.000	0.100	0.015	0.050
75/03/09	12 20		0.098	0.500	0.188	0.008	0.040
75/04/06	12 15		0.360	2.100	0.055	0.030	0.030
75/05/05	09 00		0.430	1.450	0.075	0.015	0.070
75/06/27	09 30		0.280	0.100	0.007	0.010	0.080
75/08/16	08 45		0.260	0.850	0.025	0.015	0.070
75/09/13	12 10		0.230	1.100	0.085	0.010	0.080

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STORET RETRIEVAL DATE 76/08/12

4925C1
41 24 58.0 112 03 03.0 4
UNNAMED STREAM
49 7.5 WILLARD
T/WILLARD RESERVOIR 150791
SEC RD BRDG 1 MI NW OF WILLARD
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	09 45		1.040	0.800	0.060	0.005	0.020
74/12/15	10 00		0.064	1.600	0.055	0.010	0.050
75/02/09	09 30		1.060	1.100	0.040	0.008K	0.060
75/03/09	12 35		0.302	0.600	0.152	0.016	0.040
75/04/06	12 25		1.500	2.100	0.143	0.010	0.020
75/05/05	09 15		1.200	1.300	0.045	0.010	
75/06/27	09 45		1.300	0.950	0.180	0.035	0.060
75/08/16	08 55		0.980	1.100	0.020	0.005	0.080
75/09/13	12 25		1.050	0.500	0.030	0.010	0.050

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

492501
41 24 29.0 112 02 59.0 4
UNNAMED STREAM
49 7.5 WILLARD
T/WILLARD RESERVOIR 150791
SEC RD BRDG .6 MI W OF WILLARD
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	09	55	1.140	0.700	0.020	0.010	0.010
74/12/15	09	30	1.080	0.600	0.035	0.005	0.010
75/02/09	09	45	0.945	1.000	0.040	0.010	0.030
75/03/09	12	50	1.390	0.700	0.232	0.015	0.015
75/04/06	13	05	0.810	1.750	0.070	0.005	0.010K
75/05/05	09	30	0.620	1.150	0.032	0.005K	0.010
75/06/27	09	55	0.375	1.000	0.025	0.010	0.020
75/08/16	09	10	0.680	0.340	0.025	0.005	0.050
75/09/13	12	15	0.890	0.900	0.060	0.010	0.060

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

4925E1
41 24 22.0 112 02 57.0 4
UNNAMED STREAM
49 7.5 WILLARD
T/WILLARD RESERVOIR 150791
SEC RD BRDG 1 MI SW OF WILLARD
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	10	00	1.640	0.900	0.030	0.005	0.010
74/12/15	09	35	1.760	0.100	0.020	0.005K	0.010
75/02/09	10	15	1.500	0.500	0.040	0.008K	0.030
75/03/09	13	00	0.715	1.000	0.170	0.005K	0.020
75/04/06	12	55	1.900	2.200	0.065	0.010	0.010
75/05/05	09	45	1.150	0.550	0.080	0.005	0.010K
75/06/27	10	00	0.860	0.700	0.315	0.015	0.020
75/08/16	09	20	1.900	0.150	0.015	0.010	0.050

K VALUE KNOWN TO BE
LESS THAN INDICATED

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STORET RETRIEVAL DATE 76/08/12

4925F1
41 23 47.0 112 02 42.0 4
UNNAMED STREAM
49 7.5 WILLARD
T/WILLARD RESERVOIR 150791
SEC RD BRDG 1.1 MI SW OF WILLARD
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	10	10	1.840	0.600	0.090	0.010	0.010
74/12/15	09	45	2.000	0.100K	0.025	0.020	0.020
75/02/09	10	00	2.100	0.600	0.024	0.008K	0.030
75/03/09	13	10	1.490	0.600	0.240	0.010	0.020
75/04/06	12	40	3.150	2.200	0.230		0.010K
75/05/05	10	00	3.000	1.100	0.040	0.010	0.010
75/06/27	10	10	1.700	0.650	0.055	0.015	0.020
75/09/13	12	20	1.720	0.200	0.025	0.010	0.040

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

4925G1
41 20 29.0 112 07 40.0 4
UNNAMED STREAM
49 7.5 PLAIN CTY SW
T/WILLARD RESERVOIR 150791
CULVERT 5 MI N OF WARREN CEMETERY
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	11	00	0.096	0.900	0.130	0.015	0.040
74/12/15	09	40	1.080	0.100	0.025	0.010	0.030
75/02/09	10	20	0.035	1.400	0.032	0.008K	0.050
75/03/09	14	30	2.180	1.400	0.035	0.018	0.050
75/05/05	11	15	0.005	1.800	0.070	0.015	0.060
75/06/27	11	45	0.070	1.150	0.045	0.010	0.040
75/08/16	10	20	0.020	2.000	0.045	0.010	0.080

K VALUE KNOWN TO BE
LESS THAN INDICATED

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STORET RETRIEVAL DATE 76/08/12

4925M1
41 25 16.0 112 03 39.0 4
UNNAMED STREAM (MAIN OUTLET)
49 7.5 WILLARD
O/WILLARD RESERVOIR 150791
SEC RD CLVRT 1.6 MI NW OF WILLARD
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/10	09	10	0.104	3.000	0.070	0.065	0.280
74/12/15	09	00	0.088	1.000	0.030	0.010	0.020
75/01/11	12	42	0.090	1.200	0.050	0.020	0.040
75/02/09	07	00	0.055	1.700	0.056	0.008K	0.070
75/03/09	12	00	0.006	1.000	0.024	0.015	0.060
75/04/06	12	00	0.015	3.000	0.155	0.025	0.120
75/05/05	08	30	0.030	0.850	0.015	0.010	0.130
75/06/27	09	00	0.030	0.850	0.060	0.015	0.040
75/08/16	08	30	0.015	1.900	0.100	0.025	0.110
75/09/13	12	00	0.070	1.900	0.310	0.030	0.130

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/08/12

4925YA PD4925YA P000000
41 14 00.0 111 58 00.0 4
SOUTHERN PACIFIC
49 7.5 OGDEN
T/WILLARD BAY 150791
WEBER RIVER
11EPALES 2141204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
75/02/20	12	25	8.100	4.050	0.089	0.075	0.140	0.300	0.216
75/04/03	11	30	1.080	1.600	0.050K	0.100	0.390	0.216	0.216
75/04/30	09	20	0.100	4.600	0.100	1.200	2.100	0.110	0.200
75/05/21	10	30	0.350	7.000	0.190	0.070	0.100K	0.200	
75/06/26	10	05	0.425	2.900	0.900	0.100	0.125	0.200	0.200
75/07/22	10	50	0.025	4.700	0.025K	0.035	0.330	0.050	0.100
75/09/03	14	15	0.025	7.300	0.075	0.800	1.700	0.060	0.070
75/09/25	13	00	0.025	7.700	0.025K	0.041	0.760	0.064	0.070
75/11/18	12	00	0.050	3.700	0.025K	0.075	0.300	0.050	0.060
75/12/18	11	00	1.150	8.800	0.025K	0.260	0.960	0.180	0.200

K VALUE KNOWN TO BE
LESS THAN INDICATED